Published in final edited form as:

Health Econ. 2020 September ; 29(9): 1086–1097. doi:10.1002/hec.4027.

Integrated care models and behavioral healthcare utilization: Quasi-experimental evidence from Medicaid Health Homes

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Abstract

Integration of behavioral and general medical care can improve outcomes for individuals with behavioral health conditions – serious mental illness (SMI) and substance use disorder (SUD). However, behavioral healthcare has historically been segregated from general medical care in most countries. We provide the first population-level evidence on the effects of Medicaid health homes (HH) on behavioral healthcare service use. Medicaid, a public insurance program in the United States, HHs were created under the 2010 Affordable Care Act to coordinate behavioral and general medical care for enrollees with behavioral health conditions. As of 2016, 16 states had adopted a HH for enrollees with SMI and/or SUD. We use data from the National Survey on Drug Use and Health over the period 2010 to 2016 coupled with a two-way fixed-effects model to estimate HH effects on behavioral healthcare utilization. We find that HH adoption increases service use among enrollees, although mental healthcare treatment findings are sensitive to specification. Further, enrollee self-reported health improves post-HH.

Keywords

Medicaid; serious mental illness; substance use disorder; integrated care

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Disclaimer: The views expressed in this paper are those of the authors, and no official endorsement by the Agency for Healthcare Research and Quality or the U.S. Department of Health and Human Services is intended or should be inferred.

JEL codes

I10; I13; I18

1. Introduction

Behavioral health conditions, which we define as serious mental illnesses (SMI) and substance use disorders (SUD), are common and costly ailments. Within the United States, the focus of our study, 4.5% and 7.6% of adults met diagnostic criteria for an SMI or SUD in 2017 (Center for Behavioral Health Statistics and Quality, 2018). These conditions are particularly common among Medicaid enrollees: in 2017 8.2% and 10.2% of enrollees met diagnostic criteria for an SMI and SUD respectively. Medicaid is a public insurance system jointly administered by federal and state governments, and is the primary insurer of low-income people in the U.S. The program covered 66M people in 2019 (Centers for Medicare and Medicaid Services, 2019b) with expenditures of \$582B in 2017 (Martin et al., 2019). Medicaid is the largest purchaser of behavioral healthcare services in the U.S., financing 26% of such services (Medicaid and CHIP Payment and Access Commission, 2015). Further, Medicaid enrollees are at elevated risk for behavioral health conditions, and are more likely to have chronic conditions and poor health behaviors (e.g., smoking, diabetes, cardiovascular disease) and less likely to receive guideline-concordant care for behavioral and general health conditions than other insured populations (Busch et al., 2013, Creedon and Cook, 2016, Janssen et al., 2015, Cook et al., 2014).

Healthcare payers and providers have long recommended integrating behavioral and general medical care to provide more comprehensive treatment to patients with behavioral health conditions, which should both improve patient health and reduce overall healthcare costs (American Psychiatric Association, 2016, Centers for Medicare and Medicaid Services, 2019e). However, historically the U.S. behavioral healthcare delivery system has been segregated from the general medical delivery system, with patients relying on specialty behavioral healthcare providers and often receiving inadequate care for other health conditions (Buck, 2011). This segregation has impeded efforts to integrate the two forms of healthcare.

The Affordable Care Act (ACA) of 2010 created substantial changes to the U.S. health system, with profound implications for the accessibility and quality of behavioral healthcare (McClellan and Woodworth, 2014). Several studies show that ACA-Medicaid income eligibility expansions -- which extend eligibility to all non-elderly adults with incomes up to 138% of the federal poverty level (FPL) -- substantially increase behavioral healthcare service use and shift financing from patients, local governments, and providers to Medicaid (Maclean and Saloner, 2019, Maclean et al., 2018, Meinhofer and Witman, 2018, Wen et al., 2017, Cher et al., 2019).

Beyond expanding Medicaid income eligibility, the ACA also created new programs to manage the care of enrollees with complex health needs, for example the Medicaid health home (HH) program. However, there is surprisingly limited research on the HH program, particularly compared to the vast literature exploring Medicaid income eligibility expansion

effects (Gruber and Sommers 2019). To the best of our knowledge while there have been studies of individual states, to date there has not been a national analysis that uses quasi-experimental methods (Clemans-Cope et al., 2017, Spillman and Allen, 2017). We address this important gap in the literature using National Survey on Drug Use and Health (NSDUH) data and a two-way fixed-effects model. We provide among the first causal evidence on the effects of HHs on use of behavioral healthcare services, which are of particular value to enrollees but are underused.

HHs are intended to improve access to and quality of care for Medicaid enrollees with chronic behavioral and/or somatic health conditions (Centers for Medicare and Medicaid Services, 2019a). HHs targeting behavioral health typically focus on coordinating care across specialty behavioral health and general medical providers, case management, and transitional services, e.g., management of the transition from an inpatient hospitalization to outpatient care. States pursuing HHs receive enhanced federal payment (90% federal medical assistance percentage [FMAP]) for qualified services in the first two years of an enrollee's participation in the HH program, after this period states receive the standard FMAP. Through the HH program, states can bill for services not previously reimbursed by Medicaid, including, for example, comprehensive care management, care coordination, health promotion, transitional care, patient and family support, and referral to community and social support services (Centers for Medicare and Medicaid Services, 2019a). HH program enrollment is rapidly growing among Medicaid enrollees but, to date, there are many non-engaged enrollees who are eligible and could likely benefit from the program (Centers for Medicare and Medicaid Services, 2019d).

2. Data, variables, and methods

2.1 Behavioral healthcare data

We use NSDUH data with state identifiers for the period 2010 to 2016. We begin the study in 2010 to avoid confounding from the large-scale global recession of 2007 to 2009 which is likely associated with behavioral health (Cawley and Simon, 2005, Bradford and Lastrapes, 2013, Carpenter et al., 2017, Maclean et al., 2019a). Further, we wish to focus on the post-ACA period as the policy reflects a major shift in the U.S. healthcare system. If we include earlier years we are concerned that we may not be able to adequately model this major healthcare system-wide transformation in our empirical models.

The NSDUH is a household survey representative of non-institutionalized individuals 12 or older, and is used to generate the official U.S. government statistics on behavioral health and healthcare use. Of relevance to our study, the NSDUH includes individuals who reside in households as well as non-institutional group settings (e.g., halfway houses and recovery homes), but does not include residents of psychiatric hospitals or inpatient residential facilities, incarcerated people, or homeless people. Because the HH model focuses is on community-dwelling populations we expect the NSDUH to generally include our main population of interest. However, we note that through the use of the NSDUH we may not capture all potentially eligible enrollees, e.g., enrollees who may enter an institution due to lack of adequate care in non-institutional settings or individuals who become incarcerated or homeless due to poor access to care. Therefore, we acknowledge that our use of the

NSDUH, which is advantageous in many important ways, is potentially a limitation to our study. The NSDUH annually surveys approximately 70,000 people (Center for Behavioral Health Statistics and Quality, 2017).

We focus on current Medicaid enrollees 19 to 64 years of age based on self-reported coverage at the time of the survey ($N=41,700$). The NSDUH separately assesses mental health treatment and SUD treatment by asking respondents about whether they received services in any of a list of settings in the prior year, e.g., hospital, doctor's office, mental health clinic, or rehabilitation facility. We examine any self-reported past-year mental health treatment and SUD treatment. Ideally, we would like to study specific treatment settings but sample sizes are too small for these outcomes to permit reliable analysis (full details are available on request).

2.2 HH data

The HH design and components vary across states (Centers for Medicare and Medicaid Services, 2019d). While states have the option to develop HH programs for managing non-behavioral health chronic conditions, we focus on programs that target SMI and/or SUD and are in operation in all areas of the state. Using data from CMS, we identify whether the HH covers patients with SMI only, SUD only, or both SMI and SUD.

We consider states to be HH states and in our intervention group if they adopt a HH for SMI and/or SUD (regardless of whether or not chronic conditions are also included). Three states closed their HH or combined the HH with another program during our study period. These states are included in the comparison group for the time before their HH opens and the time after their HH closes, but are considered intervention group states while their HH programs are open. States in the intervention group must offer HH services. While some states have implemented HHs in specific regions within the state, we consider HH states to be only those that have implemented statewide programs in our main analysis. That is, states with sub-state programs are considered non-HH states and are in our comparison group. We return to the issue of sub-state HH programs in robustness checking.

2.3 Methods

We estimate the two-way fixed-effects model outlined in Equation (1):

$$H_{i,s,p} = \alpha_0 + \alpha_1 \text{home}_{s,p} + P_{i,s,p} \alpha_2 + X_{s,y} \alpha_3 + \theta_s + \tau_p + \varepsilon_{i,s,p} \quad (1)$$

$H_{i,s,p}$ is a behavioral healthcare service use outcome for individual i in state s in period p (quarter-year). $\text{home}_{s,p}$ was an indicator for a HH in state s in period p . $P_{i,s,p}$ is a vector of individual characteristics. $X_{s,y}$ was a vector of annual-level state characteristics: unemployment rate, e-cigarette tax, e-cigarette indoor use ban, tobacco cigarette tax, indoor smoking bans, prescription drug monitoring program, medical marijuana law, ACA Medicaid income eligibility expansion, and the Medicaid-to-Medicare reimbursement rate ratio for primary care services (Ali et al., 2017, Centers for Disease Control and Prevention, 2019, Maclean et al., 2019b, Flood et al., 2017, Zuckerman and Goin, 2012, Zuckerman et al., 2014, Smith et al., 2015, Sabia and Nguyen, 2018). We also control for state and period

fixed-effects, which account for time-invariant state-level factors and secular trends in our outcomes. We apply linear probability models, use NSDUH survey weights, and calculate 95% confidence intervals that account for within-state clustering.

3. Results

Table 1 reports summary statistics. 23.4% and 4.5% of the sample reports any mental health and SUD treatment. 11.9 % of enrollees reside in states with a HH for SMI and/or SUD. HH effective dates for each state that adopted a HH by the end of our study period (2016) are listed in Appendix Table 1.

We next attempt to shed some light on HH program penetration within Medicaid. To the best of our knowledge, CMS has not consistently tracked this information. However, we use information available in the NSDUH data to provide some suggestive evidence on this question. To this end, we calculate the number and share of Medicaid enrollees in each state with an SUD and/or SMI (Table 2). These numbers reflect the potentially HH-eligible subgroup of the Medicaid enrollee population. However we acknowledge that there are many additional factors that could limit a Medicaid enrollee's ability to participate in the HH program. Therefore, we likely overstate the number of Medicaid enrollees eligible to participate in a HH program in our calculations reported here.

In Table 2, the first column reports (pooled across all years of our study period, 2010 to 2016) the estimate of non-elderly Medicaid enrollees with an SMI and/or an SUD in the NSDUH. Our measures of behavioral health symptomatology are indicators for an SMI in the past year and an SUD in the past year based on screeners used to capture individuals at elevated risk for these conditions in survey settings. The NSDUH measure of SMI is derived from combining two validated scales measuring psychological distress and functional impairment (Substance Abuse and Mental Health Services Administration, 2013). The NSDUH measure of SUD was derived from a series of questions that measure symptoms of substance dependence (e.g., experiencing withdrawal after substance nonuse) and abuse (e.g., experiencing negative social, legal, or occupational consequences from substance use) that were developed to be consistent with diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Revision (Center for Behavioral Health Statistics and Quality, 2016, Substance Abuse and Mental Health Services Administration, 2016).

On average each year 7,885,942 Medicaid enrollees screen positive for these conditions nationally over our study period, with the mean share of Medicaid enrollees with SMI and/or SUD across states ranging from a low of 28% in California to a high of 56% in New Hampshire. According to CMS approximately one million enrollees participate in state HHs (Centers for Medicare and Medicaid Services, 2019c), and our NSDUH data thus are in line with a substantial number of potentially eligible individuals not participating in HHs. The relatively low participation rate in HHs suggests that there are likely to be additional enrollees who could qualify for HH participation and, in turn, benefit from the program.

The extent to which low HH program engagement (relative to the population that potentially qualifies from the program) may impact our estimated HH effect sizes is unclear. On the one hand, if Medicaid enrollees with the most serious behavioral health conditions participate in the HH program, then we may overstate HH effects for the average Medicaid enrollee with an SMI and/or SUD. On the other hand, if enrollees who participate in the HH program have relatively mild behavioral health conditions, then we may understate HH effects. As participation by Medicaid enrollees in HH grows, future studies could re-assess program effects.

Table 3 reports selected results from our DD regression models (Panel A). Receipt of SUD treatment increased by 1.3 percentage points ('ppts'), or 23%, in adopting states relative to non-adopting states after HH adoption. The relative effect is large because the baseline rate of SUD treatment use is low (4.5%). While the coefficient estimate in the mental healthcare regression is positive, it is not statistically distinguishable from zero.

To explore dynamics in HH effects, we estimate a model that includes the number of periods the HH has been in effect (Table 3 Panel B). Initially, we observe that both mental health and SUD treatment increase (3.9 and 2.6 ppts), but this effect declines as time passes. These findings may capture better treatment and reduced need over time, potentially stemming from pent-up demand among enrollees who were unable to access care prior to HH adoption.

We also stratify the sample by median share of Medicaid enrollees with SMI and/or SUD in 2010. This stratification allows us to assess whether HH effects are larger in states with potentially greater shares of the Medicaid population with a qualifying health condition and are therefore potentially eligible for the program. Results are reported in Table 3 Panel C. Coefficient estimates are larger in magnitude and statistically distinguishable from zero in the sample with above median share of Medicaid enrollees with SMI and/or SUD. This pattern of results is in line with the hypothesis that HH effects should be larger in states where more enrollees could potentially enroll in and benefit from the HH program. However, 95% confidence intervals overlap and thus we do not wish to overstate heterogeneity in effect size.

The key assumption of two-way fixed-effects models is that adopting and non-adopting states would have followed the same trends in outcomes had the adopting states not implemented their HH. We estimate an event-study to investigate parallel trends (Autor, 2003). In particular, we construct quarter leads and lags surrounding the HH adoption, with the quarter prior to adoption as the omitted group. We do not report coefficient estimates for quarters more than three years before the event and two years after the event as sample sizes become small, but we do control for these indicators in the regression model. Results do not suggest that these groups of states followed differential trends pre-HH (Table 4). We interpret these findings as suggestive evidence that our NSDUH data satisfy parallel trends.

A concern with our analysis is that we are capturing the effects of increases in SMI and/or SUD, which could lead to increased treatment through a very different causal channel than allowing better access to care. That is, events coincident to the adoption of HH prompts SMI

and/or SUD among Medicaid enrollees rather than increasing service within a stable population of enrollees with these health conditions. We do not expect HH participation to lead to a reduction in the probability that an enrollee meets criteria for an SMI and/or SUD given the chronic nature of these conditions, and the features of the programs (see Section 1). To explore the possibility that HH adoption is associated with *increases* the probability that an enrollee has an SMI and/or SUD, we regress the probability of screening positive on an SMI and SUD separately (we use variables described earlier in this section). We find no evidence that adoption of a HH leads to changes in these outcomes among Medicaid enrollees (Table 5).

We consider additional outcomes that could be influenced by HH adoption (Table 5): self-rated excellent health, tobacco product use, and a measure of potentially unnecessary care that could be avoided through appropriate preventive and ambulatory care (hospitalizations). Examining these outcomes allows us to assess whether HH adoption improved health and health behaviors among enrollees, and improved care quality. HH adoption leads to a 2.2 ppt (15%) increase in the probability of reporting excellent health in adopting states, other outcomes are unchanged: coefficient estimates are small and imprecise.

4. Robustness

We conduct robustness checks. In particular, we use a definition of any HH regardless of targeted chronic condition (Appendix Table 2 Panel A), exclude states with HHs that are only available in specific regions of a state – states with programs that are limited to certain geographic regions are considered non-HH states and are included in our comparison group (Appendix Table 2 Panel B), exclude states that close their HH during the study period from the analysis sample (Appendix Table 2 Panel C), and focus on enrollees with SMI and/or SUD symptomatology (Appendix Table 2 Panel D). Results are broadly robust. We note that, within the sample of enrollees with SMI and/or SUD we observe an increase in mental healthcare treatment of 5.8 ppts and of SUD treatment of 3.8 ppts, compared to increases of 1.0 ppts and 1.3 ppts among the full analysis sample. Due to smaller sample sizes for those with SMI and/or SUD the coefficient on SUD treatment is not statistically significant.

A possible threat to our ability to estimate the causal effect of HHs on behavioral healthcare service use among Medicaid enrollees is that HH adoption may prompt some previously Medicaid-eligible individuals to take up this form of public insurance to access the newly available services. Such behaviors are a form of program induced migration and could lead to changes in the composition of Medicaid enrollees, leaving our coefficient estimates vulnerable to conditional on positive bias. However, we find no evidence that HH program adoption affects Medicaid enrollment in our data (Appendix Table 3).

We report a full set of coefficient estimates for all time-varying state-level controls and individual controls included in Equation (1) in Appendix Table 3. We re-estimate Equation (1) including only (i) individual characteristics and state- and time-fixed effects, and (ii) state- and time-fixed effects (Appendix Table 4). We acknowledge that our coefficient estimates are less precise when we exclude these controls from the regression model.

Finally, to explore the importance of access to behavioral healthcare services, we include the number of offices of physicians and non-physicians specializing in mental healthcare treatment, specialty outpatient and residential mental illness and SUD treatment providers, and psychiatric hospitals using data on the universe of establishments in the U.S. from the U.S. Census Bureau's County Business Patterns data (Appendix Table 2 Panel E).

5. Discussion

We provide among the first causal evidence on the effects of an under-studied ACA-related policy: Medicaid HHs targeting SMI and/or SUD. These programs are designed to increase access to comprehensive care among enrollees with SMI and/or SUD. Given that Medicaid enrollees have higher rates of these conditions and are less likely to receive appropriate care than the privately or Medicare insured populations, HHs may offer an important opportunity to improve access to/quality of care for enrollees. Using a two-way fixed-effects model, we show that following HH adoption the probability of using mental healthcare and SUD treatment increases in adopting states, although we note that mental healthcare findings are sensitive to specification. While HH adoption appears to improve enrollee general health, we do not observe declines in unnecessary care or improvements in chronic conditions.

While novel in many ways, our study has limitations. We rely on survey data to classify respondents as Medicaid enrollees which could contain error (Lo Sasso and Buchmueller, 2004). We examine only the early effects of HHs. HHs involve complex implementation activities, such as establishing coordinated relationships between specialty behavioral and general medical care providers (McGinty et al., 2018). Thus, effects may vary over time. Finally, our study period (2010 to 2016) was characterized by numerous changes to the Medicaid program and to insurance generally within the U.S., which implies that we may not fully isolate HH effects from other changes. This limitation is salient in our context as HH engagement is not substantial.

Our findings suggest that Medicaid HHs targeting behavioral health conditions may be a promising model for addressing the low utilization of behavioral healthcare treatment among enrollees, and for improving overall health within this population. HHs provide additional screening and case management, which may be especially helpful for SUD given widespread under-diagnosis and poor care coordination.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding: Johanna Catherine Maclean and Michael F. Pesko were supported by a Research Scholar Grant – Insurance, RSGI-16-019-01 – CHIPS, from the American Cancer Society. Brendan Saloner was supported by NIDA grant K01 DA042139. Emma E. McGinty was supported by NIMH grant K01 MH106631.

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Table 1.

Past year behavioral health outcomes and service use in all states, and states that adopted and did not adopt a state-wide Medicaid Health Home for SMI and/or SUDs by 2016 among non-elderly Medicaid enrollees: National Survey on Drug Use and Health 2010-2016

Sample:	All states, all years	Adopted, all years	Did not adopt, all years	Difference*
<i>Behavioral healthcare use (past year):</i>				
Proportion with mental health treatment	0.234	0.231	0.245	0.003
Proportion with SUD treatment	0.045	0.042	0.057	<0.000
<i>Medicaid Health Home for SMI/SUD</i>				
Proportion with any	0.119	-	--	-
<i>Individual-level characteristics</i>				
Age	38.38	38.31	38.59	0.052
Male	0.366	0.361	0.385	<0.000
White	0.656	0.671	0.607	<0.000
African American	0.248	0.238	0.281	<0.000
Asian	0.045	0.040	0.060	<0.000
Hispanic	0.235	0.250	0.187	<0.000
Less than high school	0.278	0.282	0.264	<0.000
High school	0.365	0.370	0.351	<0.000
Some college	0.275	0.275	0.274	0.854
College	0.082	0.073	0.111	<0.000
Married	0.281	0.286	0.265	<0.000
Divorced	0.035	0.035	0.034	0.527
Widowed	0.225	0.227	0.220	0.123
Single	0.459	0.452	0.481	<0.000
<i>State-level characteristics</i>				
Unemployment rate	7.018	7.17	6.532	<0.000
Tobacco cigarette excise tax per pack (2016 \$)	1.617	1.302	2.650	<0.000
Tobacco cigarette venue bans (0-3) **	0.722	0.667	0.901	<0.000
Electronic cigarette tax (any)	0.036	0.02	0.088	<0.000
Electronic cigarette venue ban (0-3) **	0.049	0.058	0.018	<0.000
Prescription drug monitoring program	0.942	0.959	0.889	<0.000
Medical marijuana law	0.460	0.471	0.425	<0.000
ACA-Medicaid income expansion	0.110	0.033	0.360	<0.000
Medicaid-to-Medicare fee ratio ***	0.398	0.392	0.418	<0.000
Observations	41,700	11,900	29,900	--

Notes: The unit of observation is a Medicaid non-elderly enrollee in a state in a quarter in a year. NSDUH sample weights are applied to the data. Sample sizes are rounded to the nearest 100 (Substance Abuse and Mental Health Services Administration, 2018).

* p -value is from a difference in proportions test between states that adopted and did not adopt a Medicaid Health Home for SMI and/or SUD by 2016.

** Tobacco and electronic cigarette venue bans include restaurants, bars, and private worksites.

*** 12 month moving average.

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Table 2.

Average annual number of non-elderly Medicaid enrollees with a behavioral health condition 2010-2016 and number of any Medicaid enrollees engaged with a Medicaid Health Home

Outcome:	Has HH for SMI and/or SUD by 2016	Average annual number of non-elderly enrollees with a behavioral health condition	Share of non-elderly enrollees with a behavioral health condition
Alabama	Y	90,213	0.35
Alaska		17,090	0.39
Arizona		240,797	0.39
Arkansas		79,977	0.41
California		977,736	0.28
Colorado		120,846	0.36
Connecticut	Y	86,198	0.32
Delaware		35,673	0.39
District Of Columbia	Y	28,783	0.31
Florida		370,901	0.32
Georgia		174,398	0.38
Hawaii		43,235	0.37
Idaho	Y	31,197	0.50
Illinois		305,707	0.29
Indiana		156,338	0.44
Iowa	Y	56,815	0.36
Kansas	Y	*	*
Kentucky		162,034	0.43
Louisiana		119,117	0.35
Maine	Y	60,021	0.43
Maryland	Y	131,300	0.36
Massachusetts		285,195	0.40
Michigan		336,747	0.39
Minnesota	Y	167,327	0.37
Mississippi		66,151	0.37
Missouri	Y	147,171	0.47
Montana		18,179	0.44
Nebraska		32,546	0.41
Nevada		53,268	0.36
New Hampshire		29,717	0.56
New Jersey		17,4193	0.36
New Mexico		76,370	0.35
New York	Y	718,156	0.32
North Carolina		215,292	0.41
North Dakota		10,844	0.38
Ohio		381,086	0.40

Outcome:	Has HH for SMI and/or SUD by 2016	Average annual number of non-elderly enrollees with a behavioral health condition	Share of non-elderly enrollees with a behavioral health condition
Oklahoma	Y	83,811	0.46
Oregon	Y	145,795	0.47
Pennsylvania		330,894	0.41
Rhode Island	Y	37,537	0.41
South Carolina		125,688	0.40
South Dakota	Y	14,503	0.50
Tennessee		174,723	0.37
Texas		316,211	0.35
Utah		45,561	0.50
Vermont	Y	36,135	0.46
Virginia		128,633	0.42
Washington		193,579	0.46
West Virginia		79,980	0.43
Wisconsin		163,664	0.38
Wyoming		8,610	0.40

Notes: Number of non-elderly enrollees 2010 to 2016 who screen positive for an SMI and/or a SUD. Data are weighted by NSDUH survey weights.

* There are no Medicaid enrollees in Kansas over our study period.

Table 3.

Effect of a Medicaid Health Home targeting SMI and/or SUD on treatment use among non-elderly Medicaid enrollees: National Survey on Drug Use and Health 2010-2016

Outcome:	Mental health	SUD
<i>Sample proportion in treatment states, pre-treatment:</i>	0.266	0.057
Panel A: Differences-in-differences		
Medicaid Health Home for SMI and/or SUD	0.010 [-0.011, 0.032]	0.013 ** [0.001, 0.026]
Panel B: Dynamic differences-in-differences		
Medicaid Health Home for SMI and/or SUD	0.039 ** [0.001, 0.077]	0.026 ** [0.003, 0.049]
Medicaid Health Home for SMI and/or SUD * linear trend since adoption	-0.017 * [-0.035, 0.002]	-0.008 * [-0.016, 0.001]
Panel C: Differences-in-difference, states below median SMI and/or SUD prevalence among Medicaid enrollees in 2010		
<i>Sample proportion in treatment states, pre-treatment:</i>	0.233	0.052
Medicaid Health Home for SMI and/or SUD	-0.002 [-0.027, 0.023]	0.016 [-0.008, 0.039]
Observations	24,200	24,400
Panel D: Differences-in-difference, states at or above median SMI and/or SUD prevalence among Medicaid enrollees in 2010		
<i>Sample proportion in treatment states, pre-treatment:</i>	0.303	0.063
Medicaid Health Home for SMI and/or SUD	0.036 * [-0.001, 0.072]	0.018 *** [0.006, 0.03]
Observations	16,500	16,600

Notes: The unit of observation is a Medicaid non-elderly enrollee in a state in a quarter in a year. See Appendix Table 1 for SMI and/or SUD HH adoption states and dates. The pre-treatment period is 2010 to the year prior to adopting for HH adopting states. NSDUH survey weights are applied to the data. All models estimated with a linear probability model and control for individual characteristics, state characteristics, state fixed-effects (i.e., a separate indicator for each state), and time fixed-effects (i.e., a separate indicator for each quarter-by-year period). 95% confidence intervals account for within-state clustering and are reported in square brackets. Sample sizes are rounded to the nearest 100 (Substance Abuse and Mental Health Services Administration, 2018).

***, **, *— statistically different from zero at the 1%, 5%, 10% level.

Table 4.

Effect of a Medicaid Health Home targeting SMI and/or SUD on treatment use among non-elderly Medicaid enrollees using an event-study: National Survey on Drug Use and Health 2010-2016

Outcome:	Mental health treatment	SUD treatment
<i>Sample proportion in treatment states, pre-treatment:</i>	0.266	0.057
Twelve quarters pre-HH adoption	-0.116 ^{**}	-0.018
	(0.056)	(0.037)
Eleven quarters pre-HH adoption	-0.063	0.024
	(0.062)	(0.038)
Ten quarters pre-HH adoption	-0.021	-0.028
	(0.052)	(0.025)
Nine quarters pre-HH adoption	-0.022	-0.022
	(0.037)	(0.028)
Eight quarters pre-HH adoption	0.046	-0.018
	(0.074)	(0.015)
Seven quarters pre-HH adoption	-0.020	0.022
	(0.071)	(0.044)
Six quarters pre-HH adoption	-0.035	-0.021
	(0.058)	(0.026)
Five quarters pre-HH adoption	0.008	-0.017
	(0.053)	(0.021)
Four quarters pre-HH adoption	0.009	-0.014
	(0.040)	(0.026)
Three quarters pre-HH adoption	0.0004	-0.016
	(0.043)	(0.020)
Two quarters pre-HH adoption	-0.026	-0.028 [*]
	(0.056)	(0.017)
One quarter prior to HH adoption (omitted category)	--	--
	--	--
Quarter of HH adoption	0.056	-0.003
	(0.046)	(0.025)
One quarters post-HH adoption	-0.045	-0.019
	(0.050)	(0.035)
Two quarters post-HH adoption	-0.009	-0.004
	(0.044)	(0.024)
Three quarters post-HH adoption	0.079	0.066 ^{**}
	(0.052)	(0.030)
Four quarters post-HH adoption	0.029	0.003
	(0.051)	(0.025)
Five quarters post-HH adoption	0.047	0.014
	(0.070)	(0.029)

Outcome:	Mental health treatment	SUD treatment
Six quarters post-HH adoption	-0.038 (0.047)	-0.005 (0.028)
Seven quarters post-HH adoption	0.008 (0.052)	-0.001 (0.016)
Eight quarters post-HH adoption	0.038 (0.024)	0.014 (0.047)
Observations	40,700	41,000

Notes: The unit of observation is a Medicaid non-elderly enrollee in a state in a quarter in a year. We construct indicators for four pre-HH adoption years and four years post-HH adoption, states that do not adopt a HH are coded as zero for all event-time indicators. The year prior to HH adoption is the omitted category. We suppress quarters outside those reported in the Table as sample sizes become small. We incorporate states' adoption of HHs for SMI and/or SUD that occur after our study period. We suppress coefficient estimates on indicators for four years in advance, and three and four years following HH adoption as sample sizes (in event-time) become very small. See Appendix Table 1 for SMI and/or SUD HH adoption states and dates. The pre-treatment period is 2010 to the year prior to adopting for HH adopting states. NSDUH survey weights are applied to the data. All models estimated with a linear probability model and control for individual characteristics, state characteristics, state (i.e., a separate indicator for each state), and time fixed-effects (i.e., a separate indicator for each quarter-by-year period). 95% confidence intervals account for within-state clustering and are reported in square brackets. Sample sizes are rounded to the nearest 100 (Substance Abuse and Mental Health Services Administration, 2018).

***, **, * = statistically different from zero at the 1%, 5%, 10% level.

Table 5.

Effect of a state-wide Medicaid Health Home for SMI and/or SUD on general health, past month tobacco product use, and past year hospitalizations among non-elderly Medicaid enrollees: National Survey on Drug Use and Health 2010-2016

Outcome:	Serious mental Illness (SMI)	Substance use disorder (SUD)	Excellent self- reported health	Hospitalizations	Tobacco product use
<i>Sample proportion in treatment states, pre-treatment:</i>					
	0.097	0.121	0.146	0.188	0.442
Medicaid Health Home for SMI and/or SUD	0.002 [−0.015, 0.02]	0.008 [−0.021, 0.037]	0.022*** [0.008, 0.036]	0.001 [−0.029, 0.031]	0.005 [−0.029, 0.038]
Observations	41,000	41,000	41,000	40,800	41,000

Notes: The unit of observation is a Medicaid non-elderly enrollee in a state in a quarter in a year. Excellent self-reported health = an indicator coded as one if the respondent reports that their general health is excellent at the time of the survey and zero otherwise. Tobacco product use = an indicator coded one if the respondent reports that they used a tobacco product (cigarettes, cigar, snus, smokeless tobacco, etc.) within the past month at the time of the survey and zero otherwise. Hospitalizations = the number of hospital admissions in the past year reported by the respondent at the time of the survey. See Appendix Table 1 for SMI and/or SUD HH adoption states and dates. The pre-treatment period is 2010 to the year prior to adopting for HH adopting states. NSDUH survey weights are applied to the data. All models estimated with a linear probability model when the outcome is binary and least squares with the outcome is continuous, and control for individual characteristics, state fixed-effects (i.e., a separate indicator for each state), and time fixed-effects (i.e., a separate indicator for each quarter-by-year period). 95% confidence intervals account for within-state clustering and are reported in square brackets. Sample sizes are rounded to the nearest 100 (Substance Abuse and Mental Health Services Administration, 2018).

***, **, *, = statistically different from zero at the 1%, 5%, 10% level.